



Real-Time Water Quality Annual Report

Northern Harvest Smolt Ltd.

January 1st to
December 31st, 2020



Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division

Introduction

- The Real-Time Water Quality (RTWQ) Monitoring Network near Stephenville, NL consists of three groundwater well monitoring stations funded by Northern Harvest Smolt Ltd. The program is a partnership between Northern Harvest and the Newfoundland & Labrador Department of Environment and Climate Change (ECC).
- Each of the three stations consists of groundwater water quality and quantity monitoring equipment (water level) which transmits data in near real-time every 2-3 hours.
- The well stations are known as: FMW10; FMW12 and MW5/6. They were installed in November 2019 by ECC staff and first deployed on November 6th 2019. The instruments remain in the monitoring wells year-round unless removed temporarily for maintenance and calibration.
- These stations measure the following water parameters: temperature, pH, specific conductivity, total dissolved solids (TDS), oxidation-reduction potential (ORP) and water quantity (depth). Parameters are recorded on an hourly basis during the deployment period and are available in real-time online:

NLGWFMW10: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW10

NLGWFMW12: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW12

NLGWMMW5/6: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWMW56

- FMW10 - This 2-inch well is one of the five wells that make up the Northern Harvest far-field monitoring network set up outside the 500m radius of the hatchery. This well is relatively deep at 19.05m.
- FMW12 – This 6-inch well is one of the thirteen wells that make up the Northern Harvest near-field monitoring network within 500m of the water supply area. This well is relatively deep at 22.89m.
- MW5/6 – This 2-inch well is one of the thirteen wells that make up the Northern Harvest near field monitoring well network within 500m of the water supply area. This is a relatively shallow well at 2.32m
- The purpose of this network is to monitor, process, and distribute water quality/quantity data to Northern Harvest Smolt Ltd. and ECC for assessment and management of water resources, as well as to provide an early warning for any potential or emerging water issues, allowing mitigative measures to be implemented in a timely manner.
- ECC will provide Northern Harvest Smolt Ltd. with deployment and annual reports. For 2019, only an annual report was generated as there were only two months of data for analysis. This 2020 report is an analysis of the first full year of real-time network data. Data is also available in near real-time on ECC's website.



Figure 1: Map of Northern Harvest Smolt Ltd. Real Time Water Monitoring Network

- Gaps in the water quality data are the result of transmission loss by the stations or the removal of inaccurate data due to ongoing station maintenance during that time period.
- The first deployment for the 2020 season began in November 2019 with the initial installation.
- In January 2020, grab samples were taken by Northern Harvest contractors. At that time, it was discovered that the FMW12 was stuck and it was lowered to its proper location.
- In February 2020, ECC staff visited the stations to make adjustments. FMW12 could not be accessed as the conduit was frozen. MW5/6 was investigated for transmission loss and after investigation, it was noted that the solar panel had moved due to the strong wind in the area. The solar panel and antennae were adjusted to resolve the issue and all solar panels on all stations were reinforced.
- The instruments were next removed for full maintenance in June 2020, followed by September 2020. In June, FMW12 was lowered to the correct depth in the casing.



(a) FMW10



(b) FMW12



(c) MW5/6

Figure 2: Northern Harvest Real Time Monitoring Network: (a) FMW10, (b) FMW12, (c) MW5/6

Maintenance and Calibration

- To ensure accurate data collection of the real time groundwater monitoring network, maintenance and calibration of the water quality instrumentation is performed approximately every four months
- Maintenance includes a thorough cleaning of each instrument and replacement of any small sensor parts that are damaged or unsuitable for reuse. Once the instrument is cleaned, ECC staff carefully calibrate each sensor attachment for pH, specific conductivity and ORP to ensure accurate data collection.
- Installation and removal dates for the 2020 season are summarized in Table 1 below.

Table 1: Water quality instrument deployment start and end dates for 2020

| Station | Installation | Removal | Duration (days) |
|---------|--------------------|--------------------|-----------------|
| FMW10 | November 6, 2019 | June 16, 2020 | 220 |
| | June 17, 2020 | September 23, 2020 | 96 |
| | September 24, 2020 | 2021 | - |
| FMW12 | November 6, 2019 | June 16, 2020 | 220 |
| | June 17, 2020 | September 23, 2020 | 96 |
| | September 24, 2020 | 2021 | - |
| MW5/6 | November 6, 2019 | June 16, 2020 | 220 |
| | June 17, 2020 | September 23, 2020 | 96 |
| | September 24, 2020 | 2021 | - |

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of each deployment period. The procedure is based on the approach used by the United States Geological Survey.
- During the maintenance phase, water levels are measured manually and a volume equivalent to three well casings is purged from each well prior to re-installation and the collection of grab samples. This process flushes stagnant water from the wells and ensures that the water being observed is aquifer water.

- After full purging of the well, the sonde is deployed and initial field readings are recorded. A grab sample is taken when possible to compare the values of pH and specific conductance against the deployed sonde’s initial values.
- Three instruments are owned by Northern Harvest and will be installed in the wells on a rotating basis to ensure data accuracy.
- Deployment comparison rankings for the stations are summarized in Table 2.

Table 2: QA/QC comparison rankings for Northern Harvest Stations

| Station | Date | Action | Instrument # | pH | Specific Conductivity |
|--------------|-----------|------------|--------------|----------|-----------------------|
| FMW10 | 6-Nov-19 | Deployment | 19D105281 | * | * |
| | 17-Jun-20 | Deployment | 19D105282 | Marginal | Excellent |
| | 24-Sep-20 | Deployment | 19E100387 | Poor | Good |
| FMW12 | 6-Nov-19 | Deployment | 19E100387 | * | * |
| | 17-Jun-20 | Deployment | 19D105281 | Fair | Excellent |
| | 24-Sep-20 | Deployment | 19D105282 | * | * |
| MW56 | 6-Nov-19 | Deployment | 19D105282 | * | * |
| | 17-Jun-20 | Deployment | 19E100387 | Poor | Good |
| | 24-Sep-20 | Deployment | 19D105281 | Poor | Fair |

*Ranking not available due to issues with collecting grab sample

Data Interpretation

- The following graphs and discussion illustrate water quality and level related events from January 1st to December 31st, 2020 at Northern Harvest Smolt facility.
- All data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

Water Temperature

- In 2020, water temperature ranged from 2.42°C to 14.07°C within the real-time well network (Table 3).
- FMW12 was very stable throughout the year, varying within a small range with a median of 6.90 (Figure 3).
- MW5/6 had the largest range of water temperatures, reaching a low in April and peaking in September, with a range of 16.49°C over the course of 2020.
- At FMW10, water temperature was relatively stable, with a notable decrease during the summer and increase again into Fall (Figure 3), indicating a possible seasonal influence.

Table 3: Water Temperature (°C) Summary Statistics from the Well Network

| | FMW10 | FMW12 | MW5/6 |
|---------------|-------|-------|-------|
| MIN. | 6.86 | 6.70 | 2.42 |
| MAX. | 8.06 | 7.24 | 14.07 |
| MEDIAN | 7.41 | 6.90 | 7.62 |

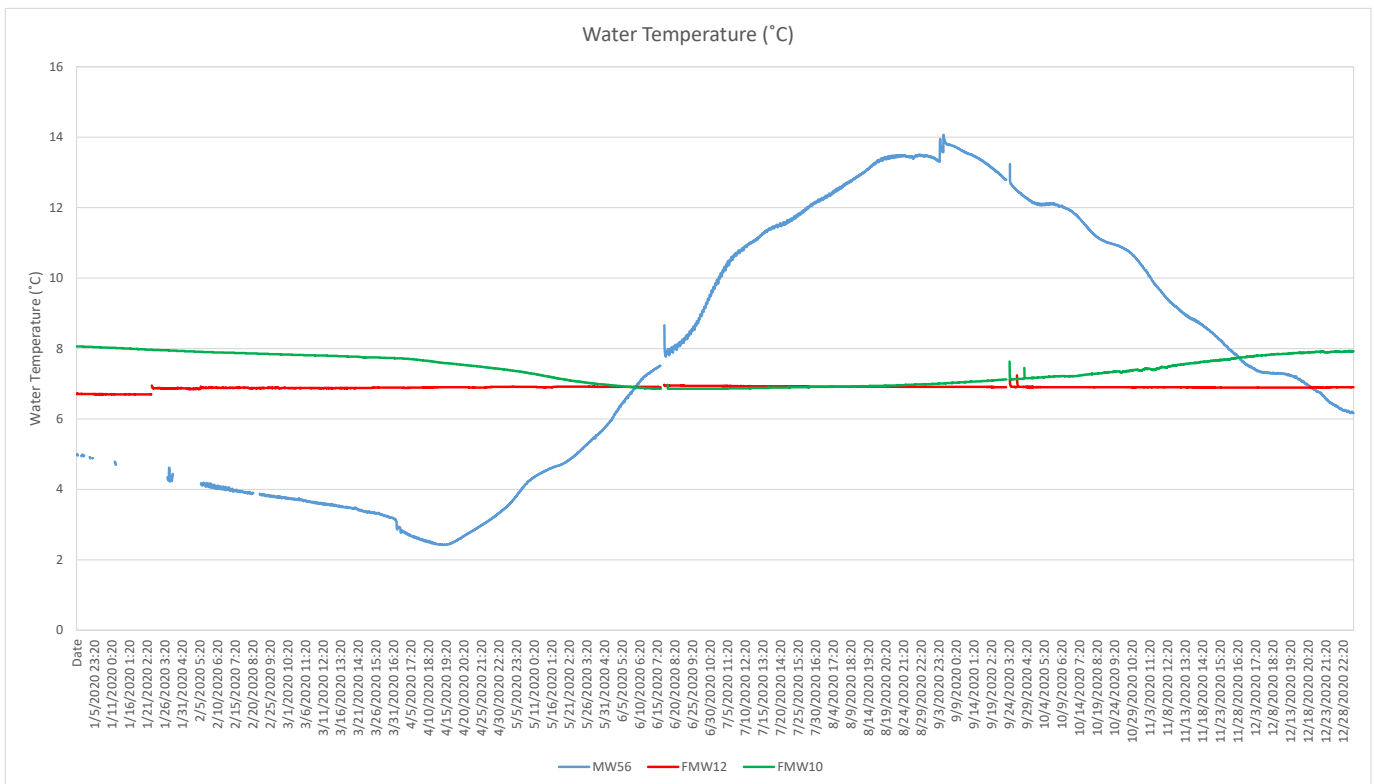


Figure 3: Water Temperature (°C) – Northern Harvest Smolt Ltd. Network

Water Depth

- Water depth at FMW12 was corrected in June 2020. The data in this report has been corrected to account for the depth change as the sonde was lowered in the well (Figure 4). In January 2020, FMW12 was discovered to be stuck in the casing and was lowered by contractors working in the well.
- During the deployment, MW5/6 was relatively stable while FMW12 showed a slight decreasing trend throughout 2020 (Table 4).
- FMW10 showed the most variability, decreasing until April before increasing into May. Water level then decreased gradually from June into December. This may be indicative of a seasonal trend.

Table 4: Water Elevation (m) Summary Statistics from the Well Network

| | FMW10 | FMW12 | MW5/6 |
|---------------|-------|-------|-------|
| MIN. | 5.16 | 9.18 | 7.66 |
| MAX. | 8.07 | 10.98 | 8.44 |
| RANGE | 2.91 | 1.80 | 0.78 |
| MEDIAN | 6.55 | 10.45 | 8.08 |

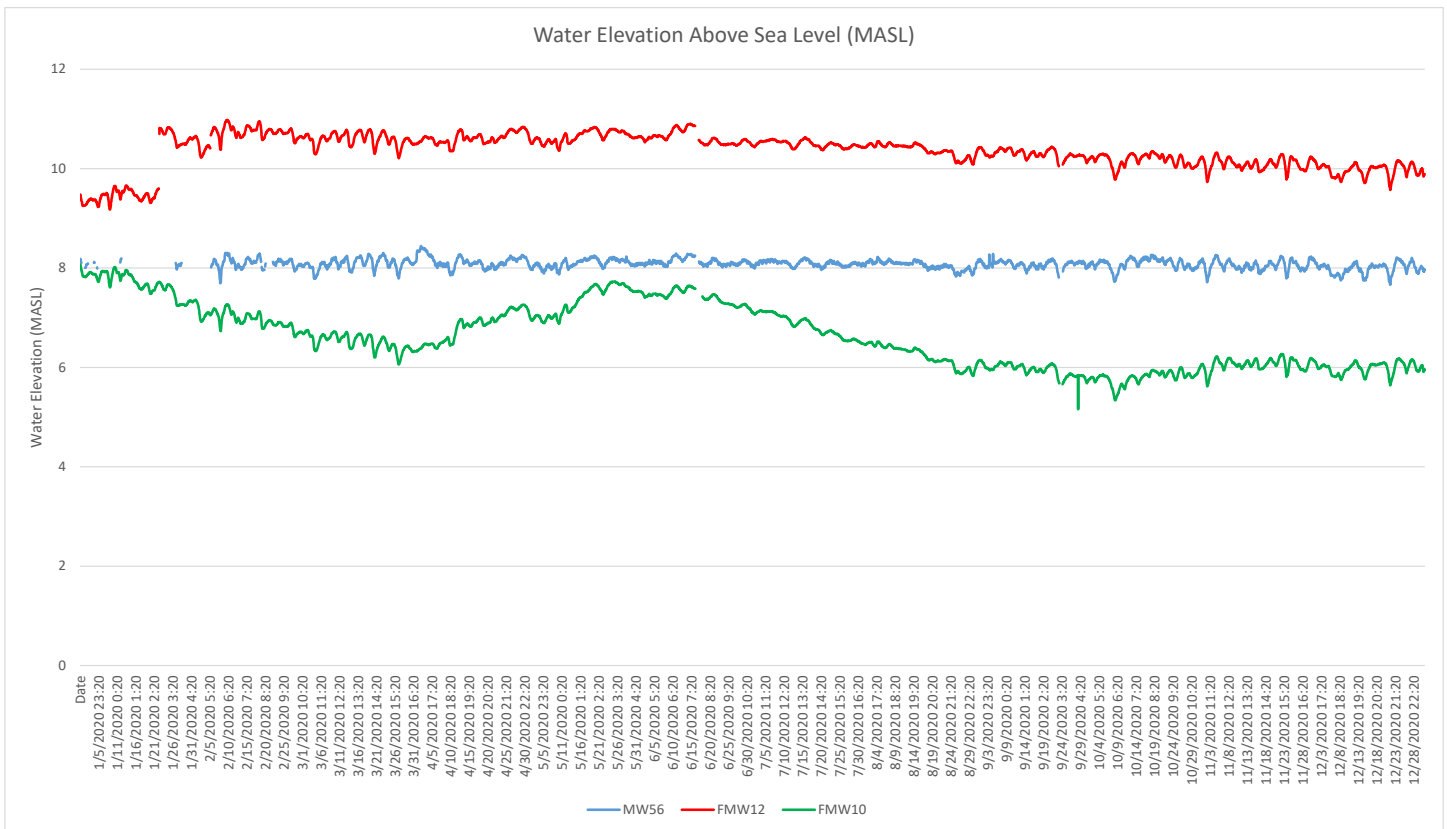


Figure 4: Water Elevation (m) – Northern Harvest Smolt Ltd. Network

pH

- In 2020, pH ranged from 5.47 (at MW5/6) to 10.80 (at FMW12) pH units within the real-time well network (Table 5).
- During the first six months of 2020, pH at FMW12 was incorrectly measured in stagnant water as the sonde was not at the correct depth. The sonde was lowered to the correct depth in June 2020 and pH dropped to just below 8 pH units and then remained stable.
- FMW10 displayed little variation. MW5/6 remained relatively stable after a sensor replacement in June. In September, an event occurred which increased the pH for a short period of time (Figure 5).

Table 5: pH (pH units) Summary Statistics from the Well Network

| | FMW10 | FMW12 | MW5/6 |
|---------------|-------|-------|-------|
| MIN. | 7.25 | 7.51 | 5.47 |
| MAX. | 7.93 | 10.80 | 6.93 |
| MEDIAN | 7.75 | 7.90 | 6.03 |

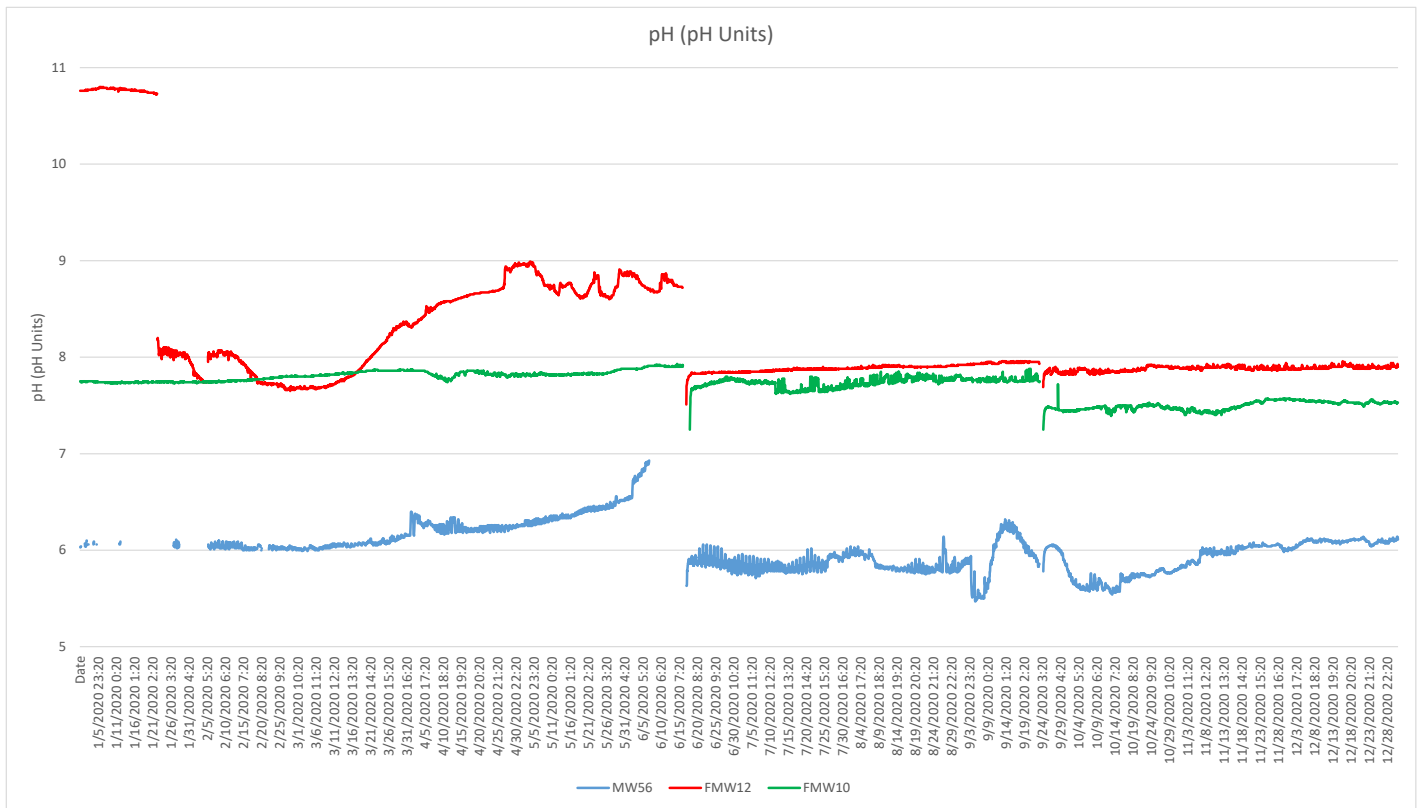


Figure 5: pH – Northern Harvest Smolt Ltd. Network

Specific Conductance and TDS

- In 2020, specific conductance ranged from 62.73 $\mu\text{S}/\text{cm}$ to 3323.29 $\mu\text{S}/\text{cm}$ within the real-time well network (Table 6).
- During 2020, FMW12 shows little variation while FMW10 slowly increases and decreases several times throughout the year. At MW5/6, values were steady until early September when conductance increased rapidly for several days before dropping again quickly. Values then fluctuated for the remainder of 2020 (Figure 6).

Table 6: Specific Conductance ($\mu\text{S}/\text{cm}$) & TDS (g/L) Summary Statistics from the Well Network

| | FMW10 | FMW12 | MW5/6 | | FMW10 | FMW12 | MW5/6 |
|---------------|----------------------|--------|---------|------------------------|-------|-------|-------|
| | SPECIFIC CONDUCTANCE | | | TOTAL DISSOLVED SOLIDS | | | |
| MIN. | 368.8 | 145.90 | 62.73 | MIN. | 0.24 | 0.09 | 0.04 |
| MAX. | 496.05 | 366.61 | 3323.29 | MAX. | 0.32 | 0.24 | 2.16 |
| MEDIAN | 434.55 | 362.51 | 121.55 | MEDIAN | 0.28 | 0.24 | 0.08 |

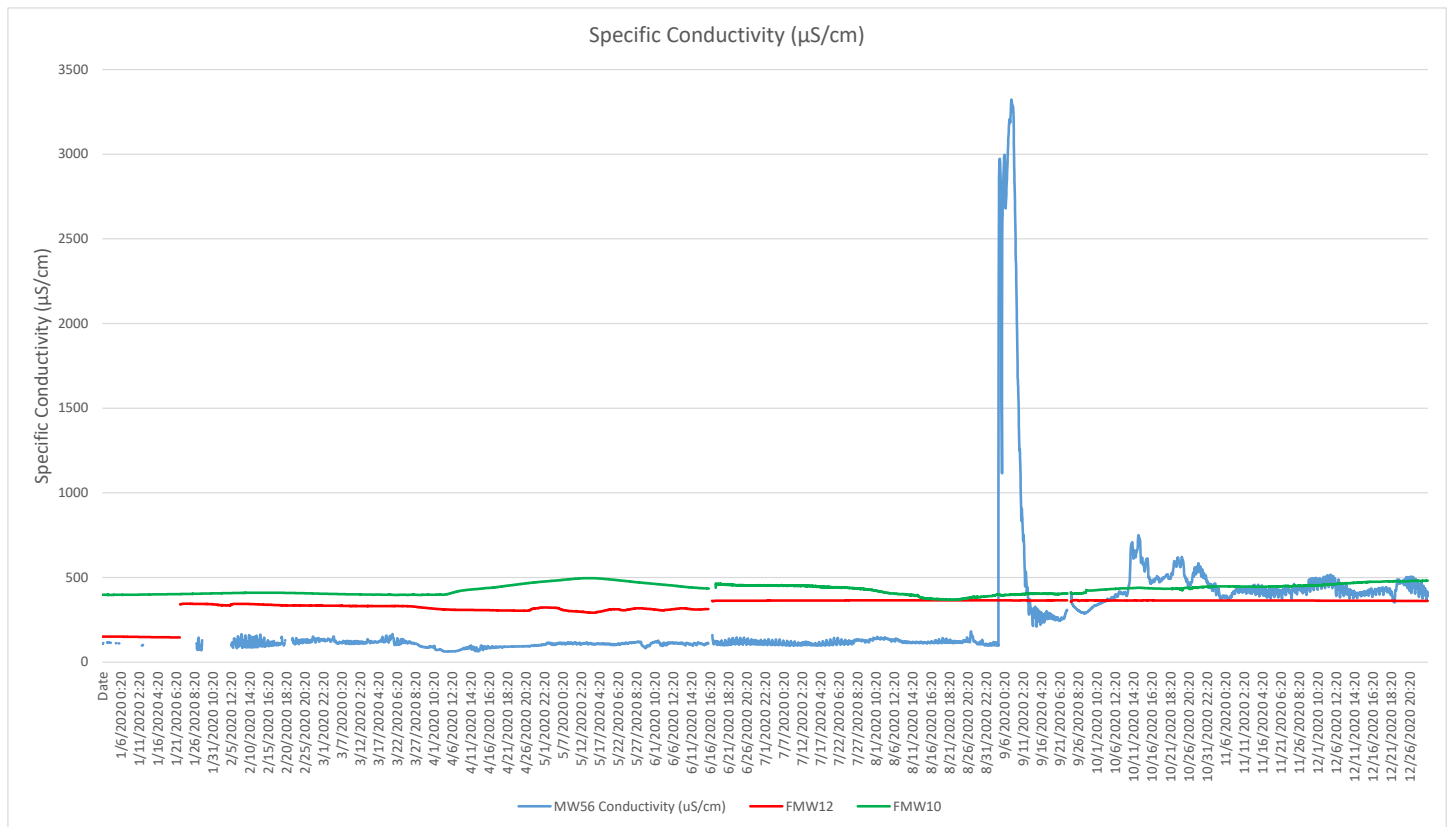


Figure 6: Specific Conductance & TDS – Northern Harvest Smolt Ltd. Network

- During 2020, total dissolved solids (TDS) ranged from 0.09 mg/L to 2.16 mg/L within the real time well network (Table 6).
- TDS varied little at FMW12 and showed some fluctuations at FMW10. At MW5/6 TDS was the lowest in the network until early September when an unknown event rapidly increased TDS for several days. Values then decreased but continued to fluctuate throughout the Fall (Figure 7).

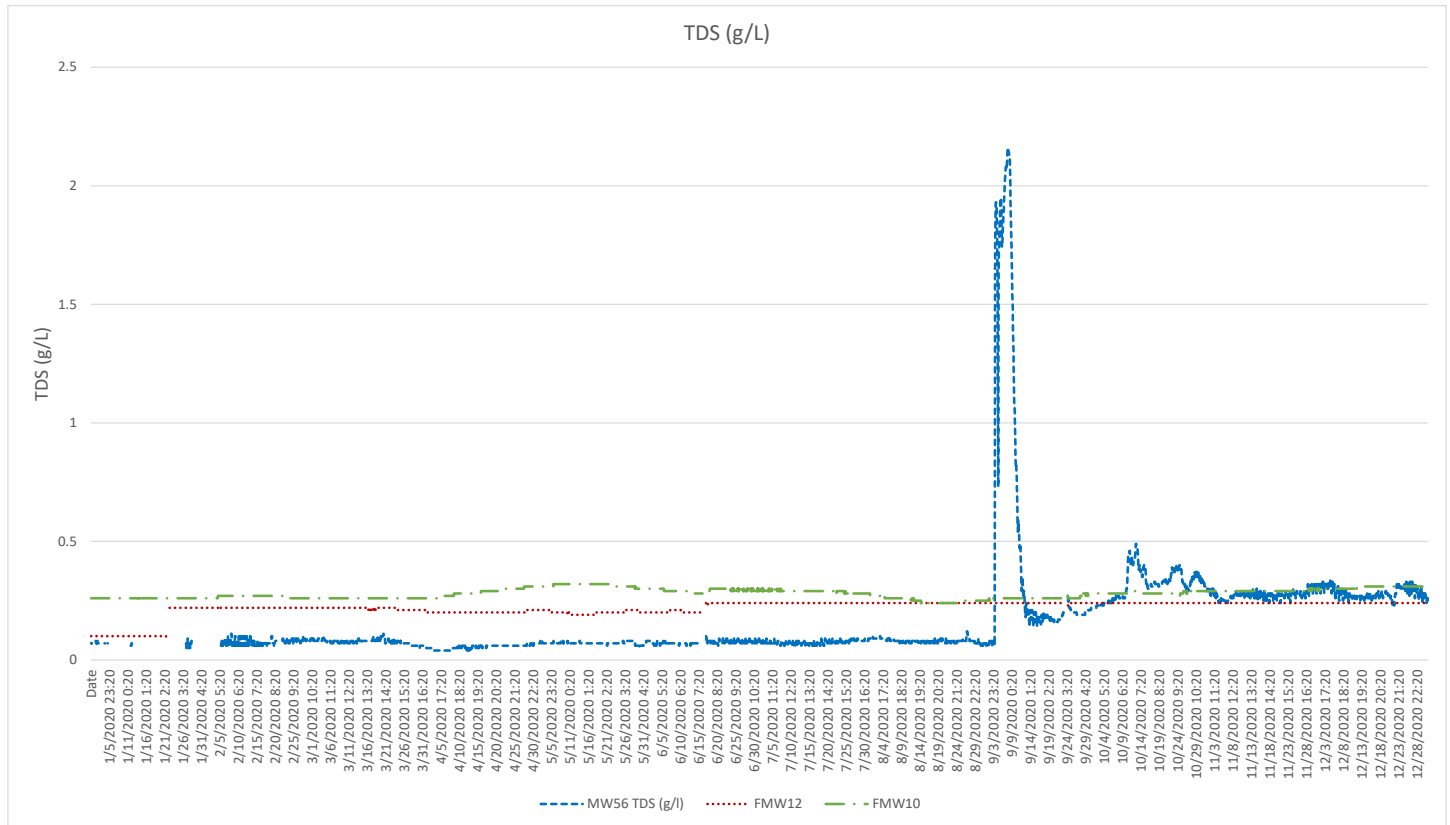


Figure 7: Total Dissolved Solids – Northern Harvest Smolt Ltd. Network

Oxidation – Reduction Potential (ORP)

- During 2020, oxidation-reduction potential (ORP) ranged from -530.31mV to 455.27 mV within the real time well network (Table 7).
- During the brief 2019 deployment year, both FMW10 and MW5/6 appeared to be oxidative in nature while FMW12 was reductive. Data from 2020 supports that FMW10 and MW5/6 are generally oxidative (Figure 8).
- The placement of the sonde in FMW12 was corrected in June 2020. Figure 8 shows that while the sonde was in the stagnant water in FMW12, the ORP was reductive. When the sonde was correctly lowered in the well, ORP demonstrated an oxidative nature. ORP at FMW12 remained largely oxidative from June to December 2020.

Table 7: Oxidation-Reduction Potential (ORP) Summary Statistics from the Well Network

| | FMW10 | FMW12 | MW5/6 |
|---------------|--------|---------|--------|
| MIN. | 68.81 | -530.31 | -15.71 |
| MAX. | 403.82 | 400.29 | 455.27 |
| MEDIAN | 368.74 | 302.66 | 310.03 |

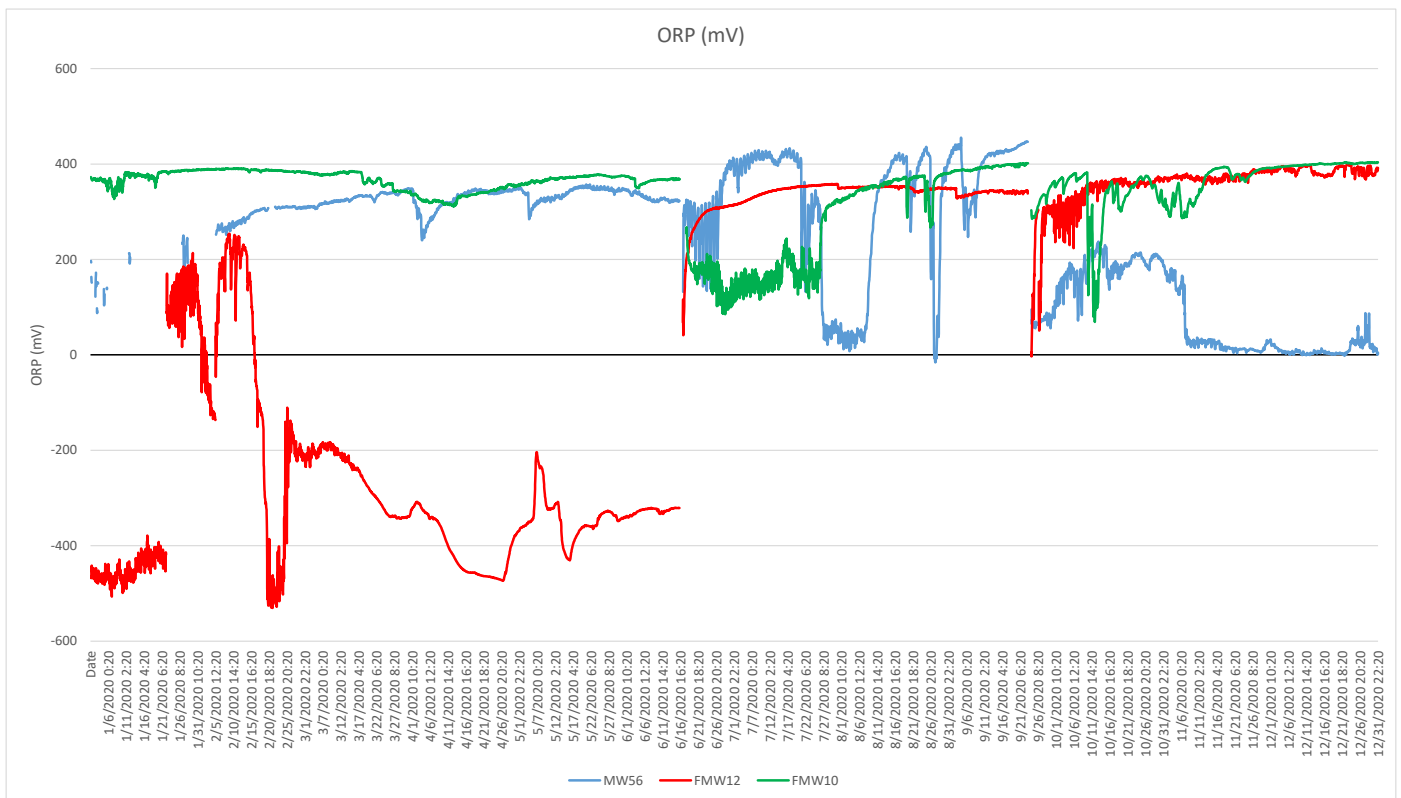


Figure 8: Oxidation-Reduction Potential (ORP) – Northern Harvest Smolt Ltd. Network

Conclusions

- The real-time water quality and quantity monitoring network at Northern Harvest Smolt Ltd was established on November 6, 2019 when instruments were initially deployed at each of the three wells in the network: FMW10, FMW12 and MW5/6.
- Since initial deployment, data has been monitored closely to determine if the instruments are accurately placed in the well casings and if there are other issues such as sensor errors.
- In 2020, the following major issues were corrected within the network: transmission errors at MW5/6 were corrected by fixing the antennae and solar panel; all solar panels were reinforced; FMW12 depth was adjusted in June to the correct depth; faulty sensors were replaced when required.
- Water elevation at FMW12 was corrected in June 2020. Data for this report has been corrected to account for this change.
- QA/QC rankings were obtained when grab samples could be collected. Equipment will be upgraded in the future to ensure grab samples can be collected at FMW12.
- Over the course of the year, water depth was relatively stable at MW5/6, slightly decreasing at FMW12 and showed variability at FMW10.
- Water temperature at FMW12 was stable, while temperatures at FMW10 showed a slight seasonal change. MW5/6 showed the most variability in the network, changing with the seasons.
- pH at FMW12 was slightly basic until June when the instrument was lowered to the correct level. pH values at FMW10 and FMW12 were relatively similar, stable and slightly acidic. MW5/6 values were much lower than FMW10 and FMW12 throughout the year. pH at MW5/6 responded to an event in the aquifer in early September. This response may be related to 31.4mm of rain which fell in the area September 3-4, 2020.
- Specific conductivity was generally lowest at MW5/6 until an event occurred over several days in early September, rapidly increasing conductance in MW5/6 only. Levels at FMW10 and FMW12 were relatively stable throughout the year with some possible seasonal changes occurring at FMW10.
- After the correction for sonde depth at FMW12 in June, ORP for all stations was generally oxidative. There were numerous fluctuations throughout the year at FMW10 and MW5/6 while FMW12 was relatively stable after it was properly placed in the well.
- During 2020, the instruments performed well with few issues. The issues identified (improper placement of sonde in well, transmission loss and possible sensor failure) were investigated and resolved in 2020.

Path Forward

- Staff will continue to monitor the data for issues.
- If necessary, deployment techniques will be evaluated and modified, ensuring secure and suitable conditions for RTWQ monitoring.
- ECC will continue to work on its Automatic Data Retrieval System (ADRS), to incorporate new capabilities in data management and data display.
- Open communication lines will continue to be maintained between ECC and Northern Harvest Smolt Ltd in order to respond to emerging issues on a proactive basis. Northern Harvest Smolt Ltd. will receive deployment reports and an annual report summarizing the events of the deployment season.

Prepared by:
Kyla Brake
Department of Environment and Climate Change
Water Resources Management Division
Phone: 709.729.3899

Appendix 1: Air Temperature and Precipitation at Stephenville, NL

